MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2017/2018

EEE 7296 – ENERGY MONITORING AND AUDITING

13th OCTOBER 2017
2.00pm - 5.00pm
(3 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 5 pages including cover page with 4 Questions only.
2. Answer ALL questions. All questions carry equal marks and the distributions of the marks for each question is given.
3. Please write all your answers in the Answer Booklet provided.

Question 1

a) Define the term 'Benchmarking'.

[4 marks]

b) What are all the benefits of Energy Benchmarking?

[4 marks]

c) Table Q1 (a) shows the dimensions of the third floor of an IT based company. 80% of the floor area has been occupied. The company works from Monday to Friday a week between 8.00 am to 5.00 pm. The energy consumption data of the company is given in Table Q1 (b). Make use of the given formula, and compute the BEI (kWh/m^2/year).

[17 marks]

Table Q1 (a) - Floor Dimensions

Section	Length (mm)	Width (mm)
Third Floor Overall Dimension	48000	32000
Common and Service Areas		
Réception Lobby	11000	8000
Lift Lobby	10000	8000
Waiting Areas	8000	8000
Registration Area	10575	5975

Table Q1 (b) - Energy consumption

Month	Air-conditioner consumption (kWh)	Lighting consumption (kWh)
January	10200	6100
February	11500	5350
March	11200	6150
April	17600	6200
May	13750	7150
June	13050	7200
July	14600	7550
August	12500	7600
September	13950	7350
October	12300	8800
November	11850	7750
December	13900	8600

Formula

$$BEI = \frac{(TBEC - CPEC - DCEC)}{(GFA - DCA - (GLA \times FVR))} \times \frac{52}{WOH}$$

TBEC – Total Building Energy Consumption (kWh/year)
CPEC – Carpark Energy Consumption (kWh/year)

DCEC – Data Centre Energy Consumption (kWh/year)
GFA – Gross Floor Area exclusive of car park (m^2)
DCA – Data Centre Area (m^2)
GLA – Gross Lettable Area (m^2)
FVR – Weighted floor vacancy rate of GLA (%)
52 – Typical weekly hours of office buildings in KL/Malaysia (hrs/week)
W O H – Weighted weekly operating hours of GLA exclusive of DCA (hrs/week)

Question 2

a) The daily energy consumption data of a Textile industry is shown in Table Q2 (a). The data were collected on Thursday and Friday from 8.00 to 17.30 hours at every 30 minutes interval. Assuming same textile production rate on both days,

(i) Plot the graph for energy consumption (kWh) versus time. Comment on the unit production cost on these two days.

[11 marks]

(ii) Analyze the data and give reasons for the hike in energy consumption.

[4 marks]

Table Q2 (a)

Time	800	830	900	930	1000	1030	1100	1130	1200	1230	1300	1330	1400	1430	1500	1530	1600	1630	1700	1730
Monday (kWhr)	2300	2500	2600	2700	3400	5300	6740	6300	7800	6720	6930	6320	5800	5900	5530	4820	4790	3490	3390	2900
Tuesday (kWhr)	2300	2700	2540	2630	2900	4890	5760	5780	5600	5400	5900	5870	5490	5600	5270	5400	4600	3120	2950	2650

b) For a University administration block, the Energy Consumption data for two years are given in Figure Q2. The University functions on Mondays to Fridays between 8.00 am to 5.30 pm. Usually, guests and students visit the administration block daily, and their head counts are given in Table Q2 (b). Analyze the energy data and explain whether the building operates efficiently or not.

[10 marks]

Figure Q2
Admin Block Electricity Consumption (kWh) 2015 and 2016

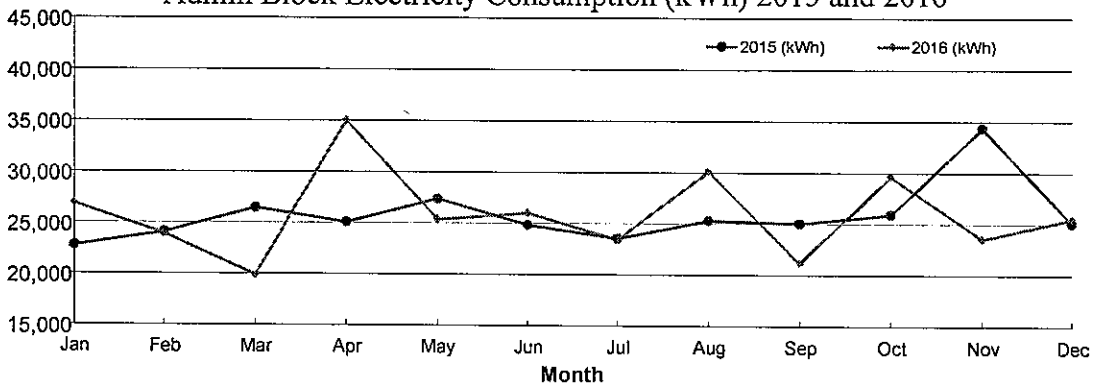

Table Q2 (b) - Number of Visitors

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Number of Visitors, 2015	1800	2050	2100	2200	2070	2150	2060	2100	2030	2120	2800	2150
Number of Visitors, 2016	2000	2100	1100	2300	2050	2100	1980	2010	1870	2050	2010	1980

Question 3

a) From the point of view of energy auditing of a small company, explain the following:

(i) ECM interactions

[5 marks]

(ii) Procedure for establishment of HVAC loads profile.

[3 marks]

(iii) Changes of load following air and water flows vs. constant flow

[3 marks]

b) In energy conservation measures, list five low cost opportunities for cost savings.

[5 marks]

c) In an unbalanced 3-phase distribution system, the load draws 150 A, 180 A and 120 A from the three phases. Compute the extra power loss due to unbalancing. Assume the neutral wire has half the cross section of the phase wires and same power factor for each load. [4 marks]

d) A small indoor stadium is to be illuminated with 10 HPMV lamps having each of 80 W rating. The other alternative is to replace the HPMV lamps with 10 groups of LED lamps having 30 W rating for each group. Both the system produces same illumination. If the cost of the LED lamp is 2.5 times the HPMV lamp, compute the number of months after which excess cost of LED lamps will be compensated by the shavings in the energy cost. Given energy cost of RM 0.2/kWh, number of working hours per day is 6. [2 marks]

e) A motor in an air-conditioner works on ON/OFF mode with 12 minutes ON and 8 minutes OFF period in each cycle. It draws full load current at 0.9 pf during the ON period. To maintain the same temperature, the motor may also run continuously at a lower speed drawing 80% of the full load current at 0.8 pf. Compute the energy saving per day.

[3 marks]

Question 4

a) Briefly explain the working of the following Energy Audit instruments.

(i) Flue Gas analyzer

[6 marks]

(ii) Leak testing and detection

[5 marks]

(iii) Remote sensing thermometer or Pyrometer

[5 marks]

(iv) Ultra-sonic flow meter for measuring fluid velocity

[5 marks]

b) One 100 Watt bulb is having length 40 cm, radius 5 cm and 0.85 emissivity. Calculate the operating temperature.

[4 marks]

End of Paper